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2010



Weathered Wyoming

AN ANNUAL STAKEHOLDER'S REPORT PRODUCED BY THE NATIONAL WEATHER SERVICE IN RIVERTON FOR RESIDENTS OF WESTERN AND CENTRAL WYOMING

A Welcome Message

From Meteorologist in Charge: Kevin Lynott

As I look back to 2010, I must say I'm very proud of the accomplishments made by the Riverton National Weather Service (NWS) Office. From a Fire Weather User's Meeting in February to the Men in Science Conference in October, we increased outreach and education to a wide variety of people and communities in which we serve. In 2010, NWS Riverton expanded programs such as Storm Spotter Training and the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS). Leadership enrichment has also been a big part of our office over the past year.

Operationally, we continue to provide the best forecast services to the people of west central Wyoming. The year 2010 was known as a year for winter storms, floods, and fires across the region. These high impact events will undoubtedly remain our focus in providing critical information for the protection of life and property.

NWS Riverton constantly strives to improve our technology and people, and this is reflected in the activities and articles contained in this report. Therefore, thank you for taking some time to read about the busy, yet productive, year NWS Riverton experienced in 2010! I expect this to continue with the support of our valuable customers and partners across west central Wyoming.



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DID YOU KNOW?

Staff from the National Weather Service in Riverton are not always located in the office during their shifts! Over the course of a year, our meteorologists and staff conduct numerous outreach events. These include school talks, civic talks, tours, and research that takes us on the road. You can request a talk for your group, classroom, or agency by visiting our webpage:

<http://www.weather.gov/riw/presentations>

On-site Weather Support During the Fremont County Flood

The building of a deep winter snowpack on the east slope of the Wind River Mountains was followed by a very significant late season snowstorm in May. In early June, warm and windy conditions prompted rapid melting of the snowpack. This led to swollen rivers in the Popo Agie and Little Wind river drainages and impacted communities from Lander through the Wind River Indian Reservation to Riverton.

Once the waters actually began flooding residences, an incident command post at the state level was set-up adjacent to the Lander fairgrounds and airport. During this time, three on-site meteorologists from the Riverton NWS office, two of which are trained IMETs (Incident Meteorologists), provided information and guidance at the incident. Among the duties of the on-site meteorologists were two daily weather briefings. One briefing was delivered to the entire incident command team in the morning for the operational shift of that day, and another in the evening during the planning meeting for the following day's shift. Services were also provided remotely by the local Riverton NWS office in the form of official weather forecasts. The on-site meteorologists acted as interpreters of the forecast and were there to answer any questions concerning the details of the forecast and to explain the atmospheric mechanics of what was happening. The local NWS service hydrologist provided up-to-date river stage forecasts at the points along the rivers of concern where river gages were located. The on-site meteorologists were also there to interpret the river forecast.



Flooding as observed on June 6, 2010.

Unlike an official dispatch where an IMET is dispatched through the higher chains of command, the IMETs serving during the flood episode were dispatched by local officials after consultation with incident command. An IMET on duty on an official dispatch will issue a weather forecast specific to the incident. In this case, the on-site meteorologist utilized the official weather forecast from the local office and tailored the forecast for the situation.



The Incident Command Post in Lander.

Other duties that were performed by the on-site meteorologists included giving a tour to the Army Corps of Engineers to help familiarize them with the geography of where the rivers flow through the area. A couple of snow samples were taken in the headwaters and later melted down to determine the water content in the snowpack. The results were then compared to area SNOTELs. The on-site meteorologists also attended two town hall meetings explaining what led up to the incident, what current conditions were like, and what the forecast held for the area. Manual river gage readings were also taken by the on-site meteorologists and media interviews were given.

In the middle of this ten day flood event another potent precipitation event dumped a significant amount of new snow in the mountains above Lander. This storm also brought another round of heavy rainfall to the lower elevations around Lander, in the foothills, and across the Wind River Basin. This event was monitored closely through snowfall measurements, rainfall amounts, and snowpack water content to discern how this would affect further runoff since the ground was already saturated.

In the future, Riverton meteorologists will be available for our expertise on such incidents, not just in the immediate local vicinity, but also anywhere else should the situation arise, anywhere within our county warning area of responsibility across western and central Wyoming.

The 2010 Men in Science Conference



On the morning of October 8, 2010, over 200 young men in grades 7 through 12 gathered at Central Wyoming College. These young men were the participants in the second Men in Science Conference, an all-day event where students were able to interactively learn about various careers in the fields of math, science, and technology. Students were able to participate in two, one-hour breakout sessions during which they were able to meet with professionals in various fields to have an interactive introduction to their careers. Some of the represented careers included: Meteorology, Zoology, Physiology, Political Science, Physical Geography, Geoscience, Veterinary Science, Atmospheric Science, Range Management, Criminal Justice, Chemistry, Biology, Microbiology, Ecology, Kinesiology, Paleontology, Molecular Biology, Science Education, Graphic Design, Entomology, and Environmental Science. These sessions were enhanced by a Keynote Speaker, Mr. Roger Hill, who spoke of his experiences as a storm chaser for Silver Lining Tours out of Denver, Colorado. Feedback from students, teachers, and speakers was quite positive from this event.

NOAA's NWS office in Riverton has been heavily involved in the development of these conferences, resulting in several weather service employees filling the roles of officers, board members, planning committee members, and/or volunteers on the day of the conference. The planning committee meets throughout the year on a monthly basis to organize the number of break-out session presenters, keynote speakers, sponsors, vendors, volunteers, and to search for grant opportunities for additional funding. Attendance has increased over the years and is now limited to a first-come, first-served basis due only to limited resources. With the continued success of these events, the Women/Men in Science Planning Committee will continue to alternate events each year pending adequate funding which is acquired through grants and local sponsorships. Plans are being developed for our sixth Women in Science Conference which will be held in 2011. If you have questions, or would like to become involved in these conferences, please contact Katy Branham or Peggy Peterson at 307-857-3898 (x381 for Peggy) or through our Email addresses: Katy.Branham@noaa.gov and Peggy.Peterson@noaa.gov.



State-Federal Partnership Leads to Increased Lightning Awareness

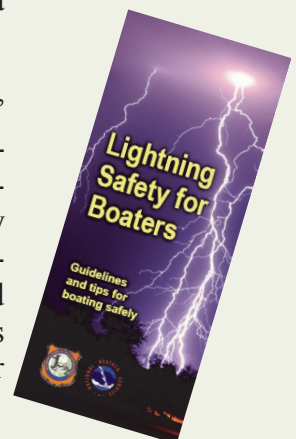


A new partnership between the Wyoming Game & Fish Department (WG&F) and National Weather Service (NWS) offices in Wyoming will lead to increased weather awareness for boaters around the state this year. The awareness campaign will specifically target boaters and other water recreationists.

As part of a U.S. Coast Guard grant, the WG&F was able to purchase floating key chains and print a safety pamphlet conceived by members of the NWS Riverton staff.

The idea arose at a meeting of NWS staff who were interested in reaching out to a segment of outdoor enthusiasts not targeted before. In recent years, thunderstorm winds had capsized a few small boats on area lakes and lightning is the #1 cause of weather related deaths and injuries in Wyoming.

Each key chain is emblazoned with the safety message, "When Thunder Roars, Head to Shore," as a reminder to boaters to get off the water when thunderstorms approach. The tri-fold pamphlet highlights tips for remaining safe on the water and various ways to obtain weather forecasts, including All Hazards NOAA Weather Radio. The WG&F plans to distribute the key chains and pamphlets when owners register their boats with the department and when conducting various outreach presentations around the state. NWS personnel at both the Riverton and Cheyenne offices will look to distribute the pamphlets through local marinas and outdoor shops throughout Wyoming. The key chains will be distributed when employees host safety talks or staff booths at fairs and trade shows.



Inaugural Outdoor Education Expo a Huge Success

Local, state, and federal agencies came together in the fall of 2010 to develop an outdoor education day for 4th graders at the Central Wyoming College's Sinks Canyon Center. Inspired by Richard Louv's best-selling book, "Last Child in the Woods," the organizers sought to give students a memorable day to inspire an appreciation for exploring the great outdoors.



Central Wyoming College (CWC) Sinks Canyon Center and National Weather Service (NWS) Riverton officials began discussing the idea of an outdoor education expo in early 2010. After a brainstorming session, employees from various other agencies were contacted to develop and plan the day-long event for 4th graders in the Lander Valley schools.

Groups of twelve students, comprised of two students from each of the six different 4th grade classrooms, visited ten separate learning stations during the expo. The stations were spread across pastures, orchards, rock-outcroppings, and meandering waters at the 127-acre facility. Students were led by college students studying within CWC's outdoor education and leadership degree program. The 4th graders had a crash course in orienteering to begin the day, which enabled them to navigate between stations using waypoints to guide them. Some of the other learning stations included, Tread Lightly and How to Wade a River, Bird Identification, Weather and Water, Geology, Trip Planning, and Wildlife Scat and Identification. After visiting each learning station the students had their "outdoor education passport" stamped by the station leader. The 26-page passport allowed students to take home memorable learning points and helpful information from their day outdoors.

SINKS CANYON
Outdoor Education Day
2010



Agencies and organizations that participated in this event included: CWC Sinks Canyon Center, U.S. Forest Service, U.S. Fish & Wildlife Service, Bureau of Land Management, Wyoming Game & Fish Department, NWS Riverton, Audubon Society, Wyoming State Forestry, University of Wyoming Extension, Popo Agie Conservation District, USDA NRCS Resource Conservation & Development, Central Wyoming College, and the National Outdoor Leadership School.

NEW ADDITIONS

The year 2010 saw a few departures from the NWS in Riverton Wyoming. We said goodbye to General Forecasters Andy Church and Roger Smith, as well as Meteorologist Intern Andy McNeel as they all move forward with their careers.

Meanwhile, we welcomed the arrival of a few new employees and celebrated a promotion. Dan Berc was promoted to General Forecaster, and Kelly Allen also joined as a General Forecaster. Two new Meteorologist Interns also joined us—Trevor LaVoie and Reid Wolcott.



Riverton Cooperative Observer Program

The Cooperative Observer Program (COOP) is a nationwide network of nearly 12,000 volunteer observers who daily record and report high and low temperatures, rainfall, and snowfall amounts from NWS supplied instruments. These sites, and their vital weather data, are the backbone of the national climate observation network, which keeps track of climate trends across the nation, such as the previous droughts that have affected much of the region. The dedicated staff at the Riverton NWS office supports 83 of these COOP sites located across western and central Wyoming.



John Greet (center) of Tensleep 16SSE is presented with the Dick Hagemeyer Award for 45 years of service by DAPM Ralph Estell (left) and Meteorologist in Charge Kevin Lynott of the NWS (right).

The Cooperative Program Management team of Ralph Estell and Rich Miller, with the assistance of Service Hydrologist Jim Fahey, travel across the state to keep instruments up and running, updating paperwork, and completing annual site inspections and training of new observers. One of the newer programs we have been working with is to connect our observers to the NWS COOP website, better known as Weather Coder-3. This web interface allows the observer to input their daily data online, and thus, eventually go “paperless.” This new program will allow the office, and other users of this data, to look at it nearly instantly. Data-hungry users won’t have to wait to the end of the month to see what happened at those sites.

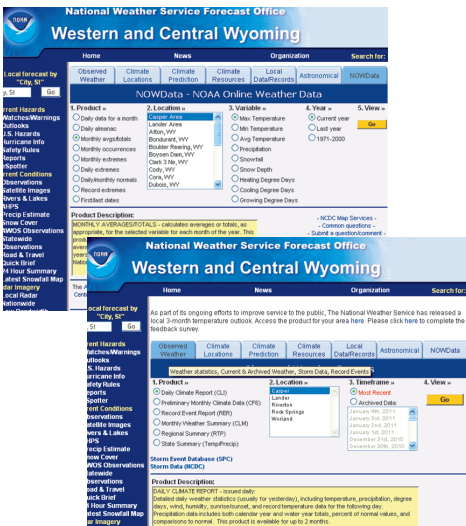
During the course of the year, a number of our long term and dedicated observers were presented with awards. Jan and Rod Mines of Farson received the

John Campanius Holm award for their 23 years of exceptional service to the COOP program. The Holm award is the Department of Commerce’s second highest award for exceptional service in the COOP program and was given to only 25 observers in 2010.



Melody Robinson (left) is presented with a Special Service Award for her service, as well as a 50 year Institution award for the Thermopolis Sewage Treatment Plant by DAPM Ralph Estell.

Our office was also able to present Length of Service Awards to: Grand Teton National Park - 100 year Institution Service Award, Thermopolis - 50 year Institution Service Award, John Greet of Tensleep 16SSE – presented with the Dick Hagemeyer Award for 45 years of dedicated COOP service, Lanny Fritz of Rairden - 25 years, Mary Bridges and Dexter Bridges of Wapiti - 15 years, Clark Weber of Mud Springs - 15 years, Beverly and Everett Holcomb of Powder River - 10 years. Additionally, Melody Robinson of the Thermopolis Sewage Treatment Plant was awarded a Special Service Award for her 32 years of COOP service.



NEED UNOFFICIAL CLIMATE DATA?

If curiosity leads you to wonder what the average maximum temperature for a month is, how much precipitation fell, or similar information, we have a website for you! NWS Riverton’s website contains a Climate page where a lot of that information is readily available. Use the link below:

<http://www.weather.gov/climate/index.php?wfo=riw>

Copious amounts of information can be found on this website, including locally produced daily and monthly climate summaries, and climate data for numerous stations across the state. If you have questions or need additional information, please call us—1-800-211-1448.

Hail and Radar Comparison Research Presented to National Audience

Research efforts attempting to discriminate between severe and non-severe thunderstorms have been around for decades. A recent 2007 study by forecasters in the Midwest analyzed several years of data in Iowa and North Dakota. Conclusions were drawn that allowed forecasters to very successfully issue Severe Thunderstorm Warnings for storms that were producing severe hail (1" or greater) in those regions.

A similar study was conducted by NWS Riverton meteorologists for observed hail in western and central Wyoming from 2004 to 2009. The ongoing research involving the correlation of observed hail size and radar reflectivity was presented at the American Meteorological Society's 25th Conference on Severe Local Storms.

It was unknown as to whether the same methodology successful in the Midwest could be applied in mountainous regions. The correlation of hail size to the maximum height of the 50 dBZ reflectivity (indicating the size and strength of the thunderstorm updraft) was found to be not as good, although the general pattern could still be noted. Overall, if the height of the freezing level is above ~7500 feet above the ground (AGL) and the 50 dBZ reflectivity height reaches at least ~20,000 feet AGL, there is a high probability that hail one inch or greater will occur. The data from 2010 will be incorporated into the data set to help refine the findings in the hope that a successful application can be developed in 2011 for the central Rockies. Similar studies are ongoing at NWS offices in Salt Lake City and Missoula, MT.

Methodologies for Producing Extended Range Forecasts Tested at Riverton

Starting in mid-October 2010, the Riverton NWS office began participating in a "test bed" to evaluate and refine the methodology to forecast weather four to eight days in the future. Eleven other forecast offices in the central Rockies, Midwest, and around the Great Lakes are also participating.

Several studies from NWS and university researchers indicate that more accurate weather forecasts can be produced in this time frame when generating a consensus of model forecast guidance. With more uncertainty this far in the future, the numerical models often times produce conflicting solutions. Many of these models are global models that best approximate weather features that span 100 to 250 miles. Since many terrain and weather features in the mountains are only 2 to 15 miles long, the models cannot be expected to accurately forecast the weather occurring in the region.

Several conclusions have already been drawn from the test after three months of participation. First, applications to correlate the rough model guidance to the mountainous terrain of Wyoming need to be improved. A method called downscaling is being used to apply the forecast guidance from scales of 50 to 100 miles down to 2 to 5 miles using high resolution topography data. Also, statistical methods are being used to modify the current forecast guidance based on performance over the past 15 days. This modified guidance is very helpful during situations

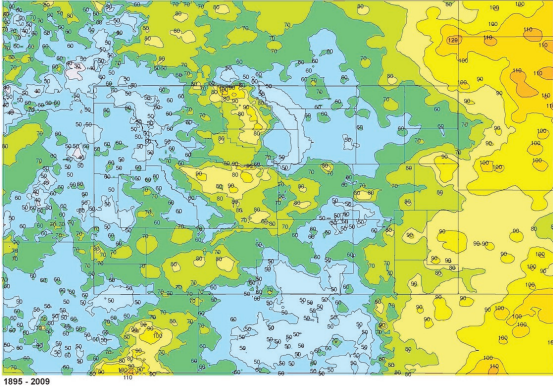
when the weather pattern does not change dramatically or when the terrain creates specific weather signals that the models cannot detect (such as river bottom cold air and warming and drying on the east slopes of mountains). Forecasters are then able to determine when to best rely on the modified guidance.

Third, as might be expected, some weather forecasting applications used in other parts of the country do not necessarily apply to mountain forecasting. There appear to be some inherent differences in weather forecasting when the elevation ranges span thousands of feet compared to hundreds of feet. It has been shown in previous studies that forecasting precipitation in the Rockies region is more difficult than any other area of the country.

Weather forecast offices in the test bed will continue to discuss and test new ideas to hopefully determine the best course of action for the forecast. It is hoped a more consistent forecast across the states will be conveyed to users, including information on how certain the forecaster is in the forecast itself. Much of the work of the test bed is also concentrating on using resources effectively, including time and computers. Forecasters are being taught how to better share and delegate responsibilities when more attention needs to be given to higher-impact weather. The test bed will run through the end of March 2011 with the hope that a more effective forecast methodology can be applied.

Wyoming Monthly Precipitation Climatology Project

November, Wyoming Region, Standard Deviation of Percent of Average Precipitation From Monthly PRISM Analysis 1895-2009. All Years.



The Wyoming Monthly Precipitation Climatology Project was started to improve the understanding of precipitation distribution and variability across Wyoming. The Project uses the monthly 4km national gridded precipitation analyses from the PRISM climatology group. This data set provides monthly precipitation analyses from 1895 to present. The national data has been clipped to the region around Wyoming. Monthly averages and the standard deviation have been computed for the 1895 to 2010 time frame, and then the percent of average has been computed for each month of each year.

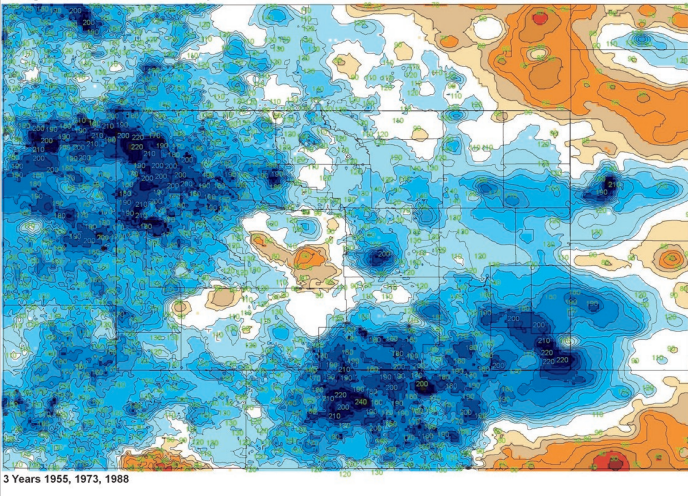
With this data set, groups of years based on the ENSO (El Nino, Southern Oscillation) and PDO (Pacific Decadal Oscillation) have been identified. The percent of average and standard deviation for each group based on strong, moderate, weak and neutral warm and cold phases of the ENSO and PDO indices are being computed to better understand the influences of these two Pacific Ocean/Atmosphere anomalies on the precipitation variation across Wyoming. Early results show promise in providing high resolution monthly precipitation outlooks for Wyoming, one to two months in the future.

The project has already completed the 2009-2010 water year (October 2009 through September 2010) analysis with percent of average precipitation for the water year. Outlooks for October and November (November images included below) have been produced and distributed internally within the National Weather Service, and to the State Climatologist.

The project aims to eventually provide precipitation event and monthly precipitation analyses based on the PRISM 800 meter grid currently used for 30 year normals, provide assessment of future monthly precipitation based on our understanding on Pacific Ocean temperature anomalies, and provide current water year analyses. Other studies relating wildfire occurrence to monthly precipitation, and streamflow variability to monthly precipitation are planned.

The project is designed to expand to monthly maximum, minimum, and average temperatures based on the 1895 to present PRISM analyses. This is planned for the 2011 year. Eventually this is expected to lead to web-based gridded temperature and precipitation climatology for Wyoming on the 4km or 800 meter PRISM grid. This would provide a 116+ year climatological record of monthly temperature and precipitation for any location in Wyoming.

November, Wyoming Region, Percent of Average Precipitation From Monthly PRISM Analysis 1895-2009. Strong Cold Years: ≤ -1.5 as defined by the Bivariate EnSo Timeseries, "BEST" ENSO Index from Smith, ESRL.



November 2010, Wyoming Region, Precipitation Outlook

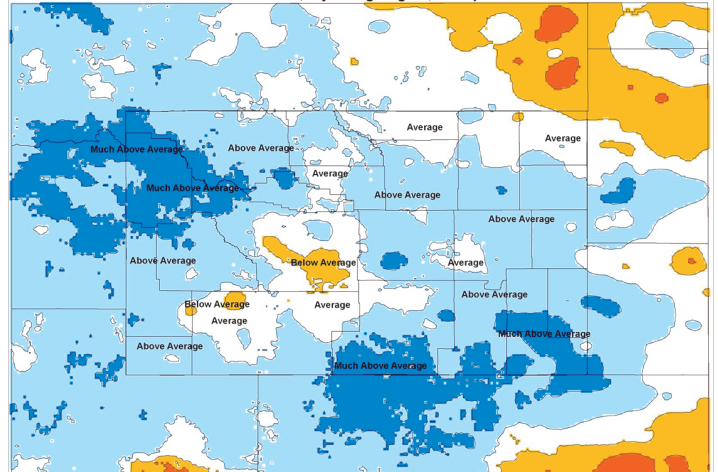


Figure 6.

Providing Critical Weather Support for Wildfires and Search and Rescue Operations

When numerous wildfires broke out across western and central Wyoming during the middle of summer and early fall of 2010, the Riverton Weather Forecast Office (WFO) provided critical weather support. This included issuing site specific spot forecasts and numerous phone briefings with the responsible land management agencies and incident command teams. The forecasts are a critical piece that incident command teams use to develop effective and safe planning strategies and tactics. Numerous search and rescue operations and prescribed burns were also similarly supported.

Wildfire activity increased in late July across western Wyoming, after a cool and wet spring delayed the onset of the fire season. A few of these large wildfires burned in Grand Teton and Yellowstone national parks. Dry and warm conditions persisted well into October allowing wildfires to burn later into the fall than is typical. The three fires presented here were the largest of the season, though several other significant fires burned during the late summer and early fall. Storms finally began to blanket western Wyoming with snow by late October.

The first large fire of 2010 was the Bull Fire. Lightning ignited the fire on July 21, 2010 in the extremely rugged Gros Ventre Wilderness, approximately 10 miles south southeast of the resort town of Jackson. Over 5,000 acres were consumed as the fire made several runs through mid fall.

Lightning sparked the Antelope Fire on September 14 in north-central Yellowstone National Park on the lower northeast slope of Mt. Washburn. Over 5,500 acres of grass and lodgepole pine forest was consumed. The road over Dunraven Pass was closed at times due to heavy smoke from the fire.



Smoke column from the Antelope Fire. Photo: National Park Service

On September 17, the wind-fanned Windmill Fire took off just north of Interstate 80, ten miles east of Evanston in extreme southwest Wyoming. Over 5,000 acres of grass, sage brush, and juniper burned over four days, and nearly over-took several wind turbines. The interstate was closed for several hours due to smoke and severely reduced visibility.

Wildfires were not the only incidents requiring site specific weather support by the Riverton NWS. Several search and rescue operations were also supported throughout the year. Two high profile search and rescue operations included rescuing climbers and a plane crash.

On July 21, lightning struck a climbing party making a summit attempt on 13,773 foot Grand Teton in Grand Teton National Park. One climber fell to his death after the strike, while several others were injured high on the mountain. This was one of the largest rescue operations ever carried out at the park.



Plane wreckage at 11,100 ft. above sea level in the northern Wind River Mountains. Photo: Fremont County Sheriff's Department

On October 25, a plane, piloted by a CEO from Minneapolis and carrying three of his sons, crashed in the rugged Wind River Mountains during a major fall snowstorm. The incident sparked a massive search for possible survivors. Upwards of 15 inches of snow had fallen in the search area making the search treacherous. NWS Riverton provided several spot forecasts and phone briefings each day of the search operations until the plane was found on November 1. Throughout 2010, several other search and rescue operations were supported by the NWS Riverton staff.

A total of 430 spot forecasts were issued during 2010, the second most issued by WFO Riverton during a single year. Of these, 272 were completed for wildfires, 13 for search and rescues, two for Hazardous Materials Releases, and 143 for prescribed burns. The average spot forecast takes approximately 35 minutes to complete, with a total of 247 hours spent producing the spot forecasts.

Explaining Climate Change

The Riverton NWS office Climate Team conducted two presentations on Climate Change as part of the Grand Teton National Park Lecture Series during the summer of 2010. The presentations were conducted by Arthur Meunier, the Riverton NWS Climate Focal Point. The first presentation was conducted at the Colter Bay Amphitheatre in July and the second presentation was at the Grand Teton National Park Visitors' Center in Moose in September. Both of these presentations were attended by approximately 50 people.

The Climate Change presentations summarized the International Panel on Climate Change findings and the more common objections to these findings. In addition to global temperatures rising over the last few decades, other data such as rising sea levels, retreating glaciers, and reduction in Arctic Sea ice were considered. The presentations showed how natural mechanisms such as volcanoes can change the climate (cooling effect), and carbon dioxide and other greenhouse gases also can force climate change by warming the planet. The focus then turned to climate change impacts on Yellowstone and Grand Teton national parks. These impacts included the potential for earlier seasonal runoffs from mountain snowpack, an increase in wildfires, and the spread of Pine Bark Beetles.

The presentations concluded with a discussion of mitigation strategies and their cost including some strategies like energy conservation that would produce net cost savings. Question and answer sessions followed the presentations. Surprisingly, no questions by any of the 50 or so attendees at each presentation contested the evidence presented or the reality of a warming world and its connection to human activities causing an increase in greenhouse gases.



Leadership Training Efforts



Training and continuing education is essential for NWS employees to stay on top of their game. Not only do meteorologists learn the latest techniques in forecasting or detecting a tornado, but in recent years the agency has seen the value in leadership training. One goal of leadership training is to impart skills and knowledge so any employee can better lead oneself, other individuals, and even organizations. At the NWS office in Riverton, we typically average a local one-hour leadership workshop every other month. Our regional headquarters offers an intensive one-year Leadership, Excellence and Development (LEAD) Program to around 15 employees. The common theme in all of this training is leadership is not a position, but a behavior that can be cultivated to inspire others to stand-up for what is right, and to pursue common objectives that benefit the organization and its stakeholders.

DID YOU KNOW?

During 2010, the NWS in Riverton completed the following:

- **13140** Site Specific Aviation Forecasts
- **430** Spot Forecasts for fire weather and incident support
- **101** Outreach Presentations which included:
 - **33** Spotter Training Talks
 - **25** School Tours and Presentations
 - **10** Civic Talks
 - **11** Community Collaborative Hail and Snow Network (CoCoRaHS) Training sessions



A New Way of Looking at SNOTEL Data

The Riverton NWS office is always looking for better and faster ways to get a snapshot of what is currently going on in our forecast area. Forecasters use the SNOTEL website, <http://www.wcc.nrcs.usda.gov/SNOTEL/Wyoming/wyoming.html>, as a tool to see how much snow has fallen at SNOTELs. Unfortunately, looking at the SNOTEL data via the website only allows forecasters to look at one SNOTEL at a time. In addition, in order to get the amount of snow that has fallen in a period of time, the calculations need to be done on the spot. NWS Riverton has developed a computer program that extracts the data from every SNOTEL and summarizes it in one document. The program calculates how much snow has fallen, snow water equivalent (SWE) of melted snow, and year-to-date precipitation change at each SNOTEL over the last 1, 3, 6 12, and 24 hours. The program also calculates the SWE estimated snowfall (6 hour) using data extracted from each SNOTEL's website. The program creates another document that reports if a SNOTEL has had three or more inches of snow in the last three hours. When this document is created an alarm is sounded, giving forecasters immediate situational awareness of where heavy snow has fallen. The program runs automatically every three hours.

For example here is a snapshot of a three hour reporting SNOTEL, Canyon, and two hourly reporting SNOTELs, Lewis Lake Divide and Snake River Station. Following is a part of the document that shows the calculations for these SNOTELs with the Snake River Station displaying the calculations for "SWE Est. Snowfall (6 hr)." These documents are sorted alphabetically within each climatological forecast zone.

<http://www.wcc.nrcs.usda.gov/nwcc/sntl-datarpt.jsp?site=384&days=7&state=wy>

<http://www.wcc.nrcs.usda.gov/nwcc/sntl-datarpt.jsp?site=577&days=7&state=wy>

CANYON SNOTEL Data Report - All Readings									
Basin: Yellowstone Headwaters (HUC 10070001) Elevation: 7870.00									
(As of: Mon Sep 20 09:50:24 PDT 2010)									
Date	Time (PST)	Snow Water Equivalent (inches)	Snow Depth (inches)	Year-to-Date Precipitation (inches)	Current Temp (degrees F)	Previous Day's Temp (degrees F)			
						Max	Min	Avg	
2010-09-19	0600	-0.1	0.0	21.7	33.8	69.4	35.1	51.3	
2010-09-19	0900	-0.1	-1.0	22.0	66.9	69.4	35.1	51.3	
2010-09-19	1200	-0.2	-99.9	22.5	72.5	69.4	35.1	51.3	
2010-09-19	1500	-0.2	-1.0	22.7	67.3	69.4	35.1	51.3	
2010-09-19	1800	-0.2	-1.0	22.5	56.5	69.4	35.1	51.3	
2010-09-19	2100	-0.2	-1.0	22.2	43.0	69.4	35.1	51.3	
2010-09-20	0000	0.0	0.0	22.0	36.3	73.4	32.5	51.6	
2010-09-20	0300	-0.1	-1.0	21.9	41.4	73.4	32.5	51.6	
2010-09-20	0600	-0.2	0.0	21.7	42.4	73.4	32.5	51.6	
Date	Time (PST)	Snow Water Equivalent (inches)	Snow Depth (inches)	Year-to-Date Precipitation (inches)	Current Temp (degrees F)	Max	Min	Avg	Previous Day's Temp (degrees F)
Provisional data, subject to revision									
*Precip(YTD) = Precipitation from October 1 to current date.									
*-99.9 indicates invalid data received.									
*M = Missing data for the selected day.									
*A blank field indicates a missing sensor or problems with the sensor.									

LEWIS LAKE DIVIDE SNOTEL Data Report - All Readings									
Basin: Snake Headwaters (HUC 17040101) Elevation: 7850.00									
(As of: Mon Sep 20 09:52:46 PDT 2010)									
Date	Time (PST)	Snow Water Equivalent (inches)	Snow Depth (inches)	Year-to-Date Precipitation (inches)	Current Temp (degrees F)	Previous Day's Temp (degrees F)			
						Max	Min	Avg	
2010-09-19	0600	-0.1	-1.0	42.0	47.3	64.6	45.3	54.7	
2010-09-19	0700	0.0	0.0	42.1	51.6	64.6	45.3	54.7	
2010-09-19	0800	0.0	1.0	42.1	54.7	64.6	45.3	54.7	
2010-09-19	0900	0.1	0.0	42.2	58.8	64.6	45.3	54.7	
2010-09-19	1000	0.1	0.0	42.3	62.4	64.6	45.3	54.7	
2010-09-19	1100	0.1	-1.0	42.4	66.2	64.6	45.3	54.7	
2010-09-19	1200	0.1	0.0	42.3	70.5	64.6	45.3	54.7	
2010-09-19	1300	0.1	0.0	42.3	68.7	64.6	45.3	54.7	
2010-09-19	1400	0.1	0.0	42.3	69.3	64.6	45.3	54.7	
2010-09-19	1500	0.1	0.0	42.4	68.4	64.6	45.3	54.7	
2010-09-19	1600	0.1	0.0	42.3	67.1	64.6	45.3	54.7	
2010-09-19	1700	0.0	0.0	42.4	62.2	64.6	45.3	54.7	
2010-09-19	1800	0.1	1.0	42.4	56.3	64.6	45.3	54.7	
2010-09-19	1900	0.0	1.0	42.3	52.5	64.6	45.3	54.7	
2010-09-19	2000	0.0	0.0	42.2	51.6	64.6	45.3	54.7	
2010-09-19	2100	0.0	-1.0	42.1	52.5	64.6	45.3	54.7	
2010-09-19	2200	0.0	0.0	42.1	52.2	64.6	45.3	54.7	
2010-09-19	2300	-0.1	1.0	42.1	52.2	64.6	45.3	54.7	
2010-09-20	0000	0.0	0.0	42.1	50.9	70.5	41.5	56.3	
2010-09-20	0100	0.0	1.0	42.2	48.6	70.5	41.5	56.3	
2010-09-20	0200	0.0	1.0	42.2	45.3	70.5	41.5	56.3	
2010-09-20	0300	0.0	1.0	42.1	45.3	70.5	41.5	56.3	
2010-09-20	0400	0.0	1.0	42.1	46.0	70.5	41.5	56.3	
2010-09-20	0500	0.0	1.0	42.2	44.1	70.5	41.5	56.3	
2010-09-20	0600	0.0	1.0	42.2	45.0	70.5	41.5	56.3	
2010-09-20	0700	0.0	1.0	42.1	46.4	70.5	41.5	56.3	
2010-09-20	0800	0.0	1.0	42.2	47.3	70.5	41.5	56.3	
Date	Time (PST)	Snow Water Equivalent (inches)	Snow Depth (inches)	Year-to-Date Precipitation (inches)	Current Temp (degrees F)	Max	Min	Avg	Previous Day's Temp (degrees F)
Provisional data, subject to revision									
*Precip(YTD) = Precipitation from October 1 to current date.									
*-99.9 indicates invalid data received.									
*M = Missing data for the selected day.									
*A blank field indicates a missing sensor or problems with the sensor.									



A New Way of Looking at SNOTEL Data (cont.)

<http://www.wcc.nrcs.usda.gov/nwcc/sntnl-datarpt.jsp?site=764&days=7&state=wy>

SNAKE RIVER STATION SNOTEL Data Report - All Readings

Basin: Snake Headwaters (HUC 17040101) Elevation: 6920.00
(As of: Mon Sep 20 10:17:34 PDT 2010)

Date	Time (PST)	Snow Water Equivalent (inches)	Snow Depth (inches)	Year-to-Date Precipitation (inches)	Current Temp (degrees F)	Previous Day's Temp (degrees F)		
						Max	Min	Avg
2010-09-19	0600	0.0	1.0	32.2	28.2	71.8	32.9	50.2
2010-09-19	0700	0.1	-1.0	32.3	39.2	71.8	32.9	50.2
2010-09-19	0800	0.1	-99.9	32.3	51.4	71.8	32.9	50.2
2010-09-19	0900	0.1	-99.9	32.3	59.9	71.8	32.9	50.2
2010-09-19	1000	0.1	-1.0	32.2	68.2	71.8	32.9	50.2
2010-09-19	1100	0.1	-1.0	32.2	72.9	71.8	32.9	50.2
2010-09-19	1200	0.0	-1.0	32.1	77.0	71.8	32.9	50.2
2010-09-19	1300	-0.1	-1.0	32.1	76.5	71.8	32.9	50.2
2010-09-19	1400	-0.1	-1.0	32.1	75.4	71.8	32.9	50.2
2010-09-19	1500	-0.1	-1.0	32.1	73.6	71.8	32.9	50.2
2010-09-19	1600	-0.1	-1.0	32.1	70.0	71.8	32.9	50.2
2010-09-19	1700	-0.1	-1.0	32.2	59.5	71.8	32.9	50.2
2010-09-19	1800	0.0	0.0	32.3	50.4	71.8	32.9	50.2
2010-09-19	1900	0.0	0.0	32.2	43.9	71.8	32.9	50.2
2010-09-19	2000	0.0	0.0	32.3	41.9	71.8	32.9	50.2
2010-09-19	2100	0.1	1.0	32.3	36.3	71.8	32.9	50.2
2010-09-19	2200	0.1	1.0	32.3	33.1	71.8	32.9	50.2
2010-09-19	2300	0.0	1.0	32.2	34.0	71.8	32.9	50.2
2010-09-20	0000	0.0	0.0	32.3	33.4	77.7	27.9	48.7
2010-09-20	0100	0.0	1.0	32.3	32.0	77.7	27.9	48.7
2010-09-20	0200	0.0	0.0	32.3	36.1	77.7	27.9	48.7
2010-09-20	0300	0.1	1.0	32.2	32.9	77.7	27.9	48.7
2010-09-20	0400	0.0	0.0	32.3	34.9	77.7	27.9	48.7
2010-09-20	0500	0.1	1.0	32.3	31.3	77.7	27.9	48.7
2010-09-20	0600	0.1	1.0	32.2	29.8	77.7	27.9	48.7
2010-09-20	0700	0.1	0.0	32.3	49.5	77.7	27.9	48.7
2010-09-20	0800	0.1	0.0	32.3	48.6	77.7	27.9	48.7
2010-09-20	0900	0.1	0.0	32.3	54.5	77.7	27.9	48.7
Date	Time (PST)	Snow Water Equivalent (inches)	Snow Depth (inches)	Year-to-Date Precipitation (inches)	Current Temp (degrees F)	Max	Min	Avg
					Previous Day's Temp (degrees F)			

Provisional data, subject to revision

*Precip(YTD) = Precipitation from October 1 to current date.
*-99.9 indicates invalid data received.
*M = Missing data for the selected day.
*A blank field indicates a missing sensor or problems with the sensor.

Sample of the first three SNOTELs in the document showing a summary of each SNOTEL using data extracted from the SNOTEL website.

1507 Sep 20 2010
Zone 1 - Yellowstone NP

CANYON	Snow	Depth	Sensor	Change	24-hr	SWE Est.	Snowfall(6 hr)
Hour 0600 PST	1	3	6	12	10:1	12:1	15:1 20:1
Snow Depth Change	M	1.0	0	1.0	0		
SWE Change	M	0	0	0	0	0	0 0
YTD Precip Change	M	0	0	0	0		

LEWIS LAKE DIVIDE	Snow	Depth	Sensor	Change	24-hr	SWE Est.	Snowfall(6 hr)
Hour 0600 PST	1	3	6	12	10:1	12:1	15:1 20:1
Snow Depth Change	0	0	0	0	2.0		
SWE Change	0	0	0	0	0.1	0	0 0
YTD Precip Change	0	0.1	0.1	0	0.2		

SNAKE RIVER STATION	Snow	Depth	Sensor	Change	24-hr	SWE Est.	Snowfall(6 hr)
Hour 0600 PST	1	3	6	12	10:1	12:1	15:1 20:1
Snow Depth Change	0	0	0	1.0	0		
SWE Change	0	0	0.1	0.1	0.1	1.0	1.2 1.5 2.0
YTD Precip Change	0	0	0	0	0		

Document, with one SNOTEL, Phillips Bench, that is reporting more than 3 inches of snow in a 3 hour period.

2106 Sep 19 2010
Zone 1 - Yellowstone NP

Zone 2 - Absaroka Mtns

Zone 7 - Owl Creek/Bridger Mtns

Zone 8 - Bighorn Mtns West

Zone 9 - Bighorn Mtns Southeast

Zone 12 - Teton/Gros Ventre Mtns

PHILLIPS BENCH

Hour 1200 PST	1	3	6	12	24-hr	SWE Est.	Snowfall(6 hr)
Snow Depth Change	4.0	4.0	2.0	2.0	4.0	10:1	12:1 15:1 20:1
SWE Change	0	0	0	0.1	0	0	0 0 0 0
YTD Precip Change	0.1	0	0	0	0		

Zone 14 - Wind River Mtns West

Zone 15 - Wind River Mtns East

Zone 22 - Casper Mtn

Zone 24 - Salt River/Wyoming Ranges

Now forecasters have one document to look at to see all the SNOTEL data in one place with calculations completed for them. These documents will greatly reduce the time needed by forecasters to look at individual SNOTEL data. If there are any questions concerning the new SNOTEL program contact Nancy Eustice at nancy.eustice@noaa.gov or Brett McDonald at brett.mcdonald@noaa.gov.

PREPARATION NEWS STORIES

With winter now in full swing, there have been a few updates to NWS Riverton's webpage. The first is to include news stories that serve as a guide for making appropriate preparations for our customers in the event of upcoming storms. These news stories will become more prevalent through the season. Some modest details of upcoming potential events and safety tips from the Riverton NWS office will be included. These preparation news stories are also expected to become more common during the planning phases of an upcoming severe weather event during the summer. Keep an eye out for these changes. Please email our webmaster at w-riw.webmaster@noaa.gov with any questions.

National Weather Service Weather Forecast Office
Western and Central Wyoming

Forecasters at the National Weather Service in Riverton, Wyoming have issued a winter storm warning across much of western Wyoming for heavy snow through early Sunday morning. Please [click here](#) for the latest statement on this ongoing significant winter storm. Road conditions could be hazardous or difficult at times during this storm. [Click here](#) for the latest road conditions from WYDOT.

This storm is expected to taper off late tonight, but a couple of winter systems will impact the Cowboy State late Sunday into Sunday night, and once again late Monday night through Tuesday night. Very frigid air is expected across the area Tuesday and Wednesday.

Here are some reminders about winter weather preparedness:

- Stay indoors if possible.
- If you must go outside, dress appropriately:
 - Multiple layers of loose-fitting clothing to promote insulation.
 - Heavy warm outdoor gear.
 - Wear a hat - 50% of your body heat escapes through your head.
 - Wear a scarf or something to cover your mouth and nose.
 - Cover as much of your skin as possible.
 - Mittens are better than gloves.
- Remember, every trip is a "MUST" trip. Plan accordingly to avoid hazardous winter travel.
- If traveling in obviously hazardous conditions, please prepare a winter vehicle safety kit. Details regarding what should be included in this kit can be found [here](#).
- Please leave your vehicle when stranded. It is your only safe source of protection from the elements.
- Additional information about traveling in the winter across Wyoming can be found on our [Winter Preparedness](#) website.

A map of current road conditions for roadways across Wyoming can be seen at the [Wyoming Department of Transportation](#) website. You can also dial 5-1-1 from any Wyoming-based telephone to receive current road closures.

Local StormReady® Communities to Grow in Number

This year saw the addition of Casper College (CC) to the [Wyoming StormReady Community](#) family. CC becomes just the second institution of higher education in the state (Laramie County Community College) to achieve the designation. Lance Jones, CC Campus Security Director, oversaw the eight-month application process. The nearly 5,000 students and faculty at CC can feel more prepared for severe weather and other natural and man-made hazards now that a set of rigorous warning criteria has been met to earn the distinction of being StormReady®.

“We are immensely pleased to be able to be designated as StormReady®. The National Weather Service is critical to the ability of the college community to be aware of hazardous weather situations. We look forward to a continuing strong partnership with our colleagues at NOAA,” said Jones. Indeed, the CC campus was impacted greatly by a flash flood that hit Casper back on July 3, 2009. Flood waters damaged several campus buildings, including the Gertrude Krampert Theatre, and sent landscaping bricks cascading down hillsides on and around campus.

Chris Jones, NWS Riverton Warning Coordination Meteorologist, commented that, “Casper College has

employed new communication services to relay alerts and officials have been proactive in helping train individuals who can provide reports to National Weather Service employees in Riverton. No question that over the past year, the college has made significant strides to enhance emergency communications to save lives and property. Campus leaders and the security staff are to be commended for making these necessary improvements to meet the StormReady® standards.”



Casper College Campus Security Director Lance Jones (second from right) is joined by NWS Riverton Meteorologist in Charge Kevin Lynott (far right), Natrona County Emergency Management Coordinator Lt. Stew Anderson (far left), and Deputy Coordinator Theresa Simpson (second from left) to celebrate the addition of Casper College as a StormReady® University.

NWS Offices Participate in Regional Water Meetings

This past spring we took to the road to share with water users the information available from the NWS. Staff from the Cheyenne, Billings, and Riverton offices partnered with the Wyoming Water Development Commission to present at four Basin Advisory Group (BAG) meetings around the state.

The BAG meetings provide an opportunity for stakeholders and other interested members of the community to come together and discuss important water-related issues, problems, and concerns affecting their river basin. The focus of the presentation was on the online and digital services the NWS provides. A highlight was the Advanced Hydrologic Prediction System (AHPS) and its provision of river forecasts and related information. The NWS websites are also a great resource for

checking on snowpack data, drought information, and seasonal and basin outlooks. Our comprehensive one-stop shopping page can be found by [following this link](#). To find out more about the BAG in your area, visit the [Wyoming Water Development Commission](#).



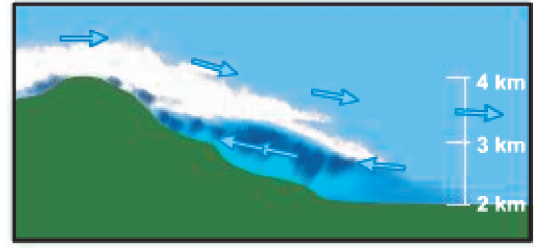
A view from above of the Pathfinder Reservoir Spillway on June 19, 2010. It was the first time since 1984 that the uncontrolled portion of the spillway was utilized. Photo Courtesy of the Bureau of Reclamation.

Research on Snowfall Distribution and Cold Air Presented at International Conference

Residents of Fremont County and other locations east of the Continental Divide are likely aware that the bulk of winter moisture falls during the upslope snows of spring. These upslope snows are the result of moist air being lifted by local terrain when the low-level wind flow is perpendicular to the terrain. Two of the more common areas where this occurs are at Lander and Casper, where the Wind River Range and Casper Mountain, respectively, favor upslope snow when the wind is from the north or northeast. Think of the low-level wind as a motorcycle daredevil and the mountain as the launching ramp; the faster the motorcycle and the higher the ramp, the better the lift. Upslope is very similar.

Research of two specific events attempted to highlight why sometimes very high snowfall totals (as a percent of average) can occur well away from the higher terrain. In the Wind River Basin, it is theorized that a dome of cold air may be the culprit.

These more extreme events occur when cold air is dammed along the east slopes of the Wind River Range. Following cold frontal passage, low-level north to northeast (upslope) flow is unable to cross the range and the wind slows down. Subsequently, the cold air is dammed against the Wind River Range. This dammed cold dome acts to modify the local terrain in such a way that overrunning south to southwest wind flow above about 13,000 feet MSL generates increased snowfall over the interior of the basin away from the barrier. Total snowfall across interior basin sites, such as Riverton, Kinnear, and Arapahoe, can approach 40% of the seasonal average in one storm. In addition, snowfall in the vicinity of Lander can exceed that of mountain locations that are 2,000 to 4,000 feet higher.



The COMET Program

A schematic of Rocky Mountain cold air damming and the overrunning flow opposing the surface flow in the cold air region (blue shaded area). In central Wyoming, arctic surges fill the Wind River Basin with typical cold pool depth of 3,000 to 5,000 feet above the ground. The overrunning upper level flow is generally from the south or southwest. Schematic courtesy of the COMET Program.

This dome of cold air and its implications on snowfall forecasting are important for providing accurate forecasts in these scenarios. One other interesting tidbit is that without the damming of the cold air the prevailing upper-level flow from the south to southwest would generate downslope flow and dry and warmer conditions in the lee of the Wind River Range. This can at times lead to damaging wind storms in foothill locations, such as Lander. The research was presented at the American Meteorological Society's 14th Conference on Mountain Meteorology. At the conference, Canadian forecasters shared their thoughts about similar challenges they face in British Columbia.

Meteorologists Represent NWS Riverton at 2010 Wyoming Aviation Conference

NWS Riverton was invited by the Wyoming Airport Operators Association to give three presentations at the 2010 Wyoming Aviation Conference in Casper on September 16 and 17. The conference was attended by 185 pilots and other aviation professionals.

Lead Forecaster Chuck Baker and General Forecaster Dan Berc gave presentations on NWS aviation services and specific services benefitting airport managers. Mr. Baker also gave an informative presentation on significant weather affecting pilots. Warning Coordination Meteorologist Chris Jones also attended as the NWS staffed a booth at the conference for the two days.

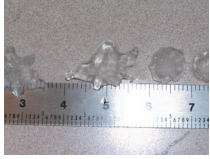


(Left to right) Lead Forecaster Chuck Baker, General Forecaster Dan Berc and Warning Coordination Meteorologist Chris Jones at the Wyoming Aviation Conference



Riverton Trains New Precipitation Observers

NWS Riverton meteorologists conducted precipitation measurement training at eleven locations across western and central Wyoming in October and November of 2010. This training was in support of the Community Collaborative Rain, Hail & Snow Network (CoCoRaHS).



CoCoRaHS is a grassroots program, founded in 1998 at the Colorado Climate Center at Colorado State University where volunteers report daily precipitation online. These observations go into a national database that is free and accessible to all. Daily precipitation reports are mapped on the CoCoRaHS website. There are currently over 15,000 volunteer observers nationwide.



The training session teaches volunteers how to properly measure rain and snow while introducing them to the equipment used by current CoCoRaHS observers. Also included is a tour of the CoCoRaHS website and information about how to join CoCoRaHS and how to obtain precipitation measuring equipment.



We look forward to conducting more training sessions in 2011. Check our website at <http://www.weather.gov/riverton> for times and locations as autumn approaches. More information about CoCoRaHS and how you can become an observer can be found at <http://www.cocorahs.org>.

Support Services and Emergency Response Tested in Volcano Exercise

In early November 2010, Brett McDonald (Science and Operations Officer) and Katy Branham (General Forecaster) travelled to Billings, MT for the 14th Annual Great Divide Workshop. The kick-off event of the workshop was a tabletop exercise that simulated an explosion of the Yellowstone Caldera.

The exercise brought together a wide range of participants from weather forecasters to county emergency managers to transportation supervisors. Six groups were organized to discuss different aspects of the impacts and response to such an explosion. All of the participants came away enlightened as to different thought processes that need to be considered in

such an event. It was readily apparent that individual agencies need to become more aware of the capabilities and services offered by other agencies so that all involved can provide appropriate support.

In addition to the exercise, several presentations were given by directors of western U.S. volcano observatories to discuss the hazard monitoring of volcanic activity. These presentations were very informative for the weather forecasters in the audience. A long distance presentation is planned for the staff at the Riverton, WY weather forecast office in the spring to better understand potential impacts around the Greater Yellowstone Area.

BY THE NUMBERS



Protecting lives and property is part of the motto of the National Weather Service. To meet this goal, the forecasters at the NWS in Riverton issue numerous severe weather related statements throughout the year. During 2010, this included:

- **20** Red Flag Warnings (Fire Weather)
- **45** Winter Weather Advisories
- **21** Winter Storm Warnings
- **42** Severe Thunderstorm Warnings
- **4** Tornado Warnings and
- **6** Flash Flood Warnings



NWS Riverton, WY

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